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Progress in understanding the prepulse and multiple pulse techniques

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Over the last several years the use of the prepulse technique has gained wide spread acceptance and opened the door for producing X-ray lasing in low-Z neon-like ions. We will present modeling of the prepulse technique which shows the important role that refraction plays. For the case of the germanium laser, we will present experiments which compare the relative merits of using the prepulse technique to compensate for refraction as compared with the use of curved targets. Recent two-dimensional imaging experiments of prepulse driven plasmas will also be discussed.

Using a series of 100 ps pulses 400 ps apart to illuminate germanium targets, we present results which show the $3p \rightarrow 3s(J = 0 \rightarrow 1)$ transition at 196 Å to completely dominate the other laser lines. Time resolved data shows the usual pair of $J = 2 \rightarrow 1$ lines at 232 and 236 Å to lase after the $J = 0 \rightarrow 1$ line. Using these short pulses together with a traveling wave geometry we are able to produce bright, short X-ray pulses which can be used in imaging experiments. To understand these plasmas, we present the first high-magnification(x 28), two-dimensional, spatially-resolved, near-field images of the laser output for the short-multiple-pulse driven germanium plasma. One and two-dimensional LASNEX hydrodynamic results are combined with XRASER kinetics and radiation transport calculations to model these plasmas. The LASNEX/XRASER results are input to a refraction code to predict the spatial and angular output of the laser. We present a comparison of the experimental results with the simulations.

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